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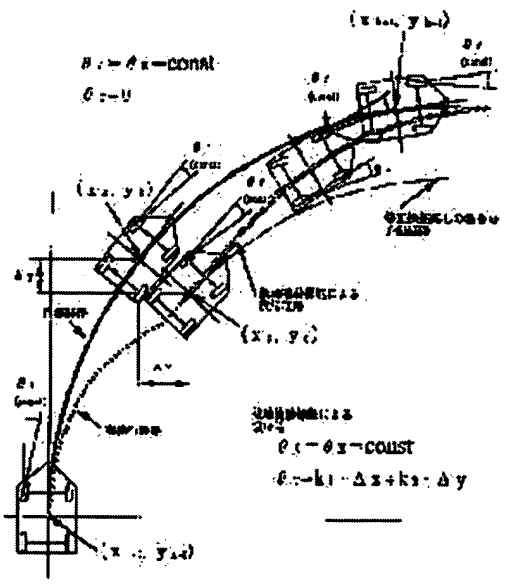
(54) AUTOMATIC PARKING DEVICE

(57)Abstract:

PROBLEM TO BE SOLVED: To promptly correct a departure from a target parking route by detecting deviation amount from the parking route of the present location of a vehicle by detecting the present location and performing a corrected steering according to deviation amount.



SOLUTION: In steering spots (Xk-1, Yk-1), suppose a steering of a target steering angle θ f is performed by a main control system and a vehicle starts along a parking target route shown by a solid line. But, suppose the vehicle deviates from the target parking route, travels on the actual traveling route shown by a broken line and arrives at a spot (Xc, Yc). Then, a target steering auxiliary angel θ r is calculated from errors Δx, Δy with the target parking route at the spot (Xc, Yc). A front wheel steering angle by the main control system from the spot (Xc, Yc) remains the target steering angle θ f as it is, and the rear wheel auxiliary steering of the target auxiliary steering angle θr is performed by a corrected auxiliary control system. Thus, the actual traveling route gradually approaches the original target parking route and the actual traveling route is recovered to the target parking route in the vicinity of the spot (Xk+1, Yk+1).

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* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the automatic parking equipment to which a parking path is calculated and a car is automatically moved to a parking location.
[0002]
[Description of the Prior Art] The automatic parking equipment to which the induction path to a parking location is calculated and a car is automatically moved to a parking location is known (for example, refer to JP,6-75629,A). In order to move a car in accordance with a target parking path, according to a car location, steering, driving force, and damping force are controlled by this kind of equipment.
[0003]
[Problem(s) to be Solved by the Invention] By the way, it may stray off a target parking path by the inclination of the road surface of a parking path, change of the tire radius by the car loading object, etc. In such a case, if it strays off a target parking path, a path operation will be redone, and in accordance with the newly calculated target parking path, steering, driving force, and damping force are controlled by conventional automatic parking equipment. However, with conventional automatic parking equipment, when a path operation is redone whenever it strays off a target parking path since the path operation to a parking location takes time amount, there is a problem that the time amount which automatic parking takes will become long.
[0004] The purpose of this invention is to offer the automatic parking equipment which corrects deviation from a target parking path whether you are Sumiya.
[0005]
[Means for Solving the Problem]
(1) Invention of claim 1 is applied to automatic parking equipment equipped with a perimeter environmental detection means detect the perimeter environment of a car, an operation means calculate the path to a parking location and its parking location based on the perimeter environment of a car, and the automatic parking control means that controls the transit driving gear of a car, a brake mechanism, the main steering-gear style, and an automatic transmission, and move a car to a parking location automatically in accordance with a parking path. And it has a current District Public Prosecutor's Office appearance means to detect the present location of a car, an amount detection means of blanks to detect the amount of blanks from the parking path of the present location of a car, and the auxiliary steersman stage that performs correction steering according to said amount of blanks.
(2) The automatic parking equipment of claim 2 is made to perform correction steering by the rear wheel auxiliary steering gear style to which an auxiliary steersman stage performs auxiliary steering of a rear wheel.
(3) The automatic parking equipment of claim 3 is made to perform correction steering by the front-wheel auxiliary steering gear style to which an auxiliary steersman stage performs auxiliary steering of a front wheel.
(4) An auxiliary steersman stage is equipped with a left rear ring brake mechanism and a right rear ring brake mechanism, controls independently a left rear ring brake mechanism and a right rear ring brake mechanism, and the automatic parking equipment of claim 4 is made to perform correction steering.
(5) An auxiliary steersman stage is equipped with a forward left ring brake mechanism and a forward right ring brake mechanism, controls independently a forward left ring brake mechanism and a forward right ring brake mechanism, and the automatic parking equipment of claim 5 is made to perform correction steering.
(6) As for the automatic parking equipment of claim 6, an auxiliary steersman stage is made to perform correction steering by the front-wheel main steering gear style according to said amount of blanks.
(7) Invention of claim 7 detects the perimeter environment of a car, and calculates a parking location and a parking path. The transit driving gear, the brake mechanism, the main steering gear style, and automatic transmission of a car

are controlled. It is applied to the automatic parking equipment which moves a car to a parking location automatically in accordance with a parking path, and the present location of a car is detected, the amount of blanks from the parking path of a its present location is detected, and an auxiliary steering gear style performs correction steering according to said amount of blanks.

[0006]

[Effect of the Invention]

(1) According to invention of claim 1, the present location of a car is detected, the amount of blanks from the parking path of a its present location is detected, and the auxiliary steering gear style was made to perform correction steering according to the amount of blanks. By this, whenever it strays off a parking path, it is not necessary to redo the path operation from the location, and it is not necessary to correct a path. Since the main steering in alignment with the original parking path is left as it is and an auxiliary steering gear style performs correction steering according to the amount of blanks from a parking path, it can return to the parking path of the beginning [be / you / Sumiya], the operation of the parking path which time amount requires is omitted, and parking can be ended correctly early.

(2) Since according to invention of claim 2 the rear wheel auxiliary steering gear style which performs auxiliary steering of a rear wheel was made to perform correction steering when it strayed off a parking path, in addition to the effectiveness of above-mentioned claim 1, the rear wheel steering gear style used for the usual four-flower steering can be used, and it is not necessary to prepare an auxiliary steering gear style separately.

(3) Since according to invention of claim 3 the front-wheel auxiliary steering gear style which performs auxiliary steering of a front wheel was made to perform correction steering when it strayed off a parking path, while the same effectiveness as claim 1 is acquired, unlike the time of rear wheel steering, car behavior turns into behavior without the sense of incongruity of only a front wheel.

(4) Since according to invention of claim 4 a left rear ring brake mechanism and a right rear ring brake mechanism are controlled independently and it was made to perform correction steering, when it strayed off a parking path, while the same effectiveness as claim 1 is acquired, it is not necessary to prepare a separate auxiliary steering gear style and, and more delicate control can be performed.

(5) Since according to invention of claim 5 a forward left ring brake mechanism and a forward right ring brake mechanism are controlled independently and it was made to perform correction steering, when it strayed off a parking path, while the same effectiveness as claim 1 and claim 4 is acquired, since all controlling mechanisms are in a front-wheel side, it can arrange efficiently near an engine room.

(6) Since according to invention of claim 6 the front-wheel main steering gear style was made to perform correction steering according to said amount of blanks when it strayed off a parking path, in addition to the effectiveness of claim 1, it is not necessary to prepare a correction auxiliary steering gear style separately.

(7) Whenever it strays off a parking path, it is not necessary to redo the path operation from the location, and according to invention of claim 7, it is not necessary to correct a path. Since the main steering in alignment with the original parking path is left as it is and an auxiliary steering gear style performs correction steering according to the amount of blanks from a parking path, it can return to the parking path of the beginning [be / you / Sumiya], the operation of the parking path which time amount requires is omitted, and parking can be ended early.

[0007]

[Embodiment of the Invention]

- Gestalt- drawing 1 of the 1st operation shows the 1st configuration of the gestalt of operation. Front wheels 1a and 1b are steered by the front-wheel steering gear style 2, and rear wheels 3a and 3b are steered by the rear wheel auxiliary steering gear style 4. The front-wheel steering gear style 2 is driven by the motor 5 for a front-wheel steering drive, and drives the rear wheel auxiliary steering gear style 4 with driving gears, such as electric ******. Moreover, Brakes 6a and 6b are formed in rear wheels 3a and 3b, respectively, and braking is applied to rear wheels 3a and 3b by Brakes 6a and 6b at the time of a stop. These brakes 6a and 6b are driven with the oil pressure braking actuator 7.

[0008] The laser radars 9a-9d for detecting CCD cameras 8a-8d for picturizing the perimeter environment of a car (detection) and the obstruction of the car circumference, respectively are installed in anterior part right and left and posterior part right and left of a car. Moreover, the wheel speed sensors 10a-10d for detecting the rotational speed of each ring are installed in each rings 1a, 1b, 3a, and 3b of a car, respectively. Furthermore, the yaw rate sensor 11 detects the yaw angle of a car.

[0009] Perimeter map generation equipment 20 detects the obstruction of the car circumference with laser radars 9a-9d, compounds a white line map and an obstruction map, and creates the map of the perimeter of a car while it processes the image of the perimeter [car] environment picturized by CCD cameras 8a-8d and detects a white line. The parking path arithmetic unit 21 calculates a target parking location and a parking path based on the perimeter [car] map created with perimeter map generation equipment 20. And according to the parking location and parking path which

were calculated, the front-wheel steering driving gear 22 drives the motor 5 for a front-wheel steering drive, and the oil pressure braking driving gear 23 drives the oil pressure braking actuator 7.

[0010] Self-vehicle location presumption equipment 24 presumes the current position of a self-vehicle based on the yaw rate detected by the yaw rate sensor 11 and each wheel speed detected by the wheel speed sensors 10a-10d. Path error detection equipment 25 detects an error with the current position presumed with the parking path and the self-vehicle location presumption equipment 24 which were calculated with the parking path arithmetic unit 21. The correction steering driving gear 26 drives the rear wheel auxiliary steering gear style 4 according to the error of the parking path and the current position which were detected with path error detection equipment 25, and performs correction steering of rear wheels 3a and 3b.

[0011] Perimeter map generation equipment 20, the parking path arithmetic unit 21, the front-wheel steering driving gear 22, the oil pressure braking driving gear 23, the motor 5 for a front-wheel steering drive, the front-wheel steering gear style 2 and the oil pressure braking actuator 7, and brake calipers 6a and 6b constitute a main control system, and self-vehicle location presumption equipment 24, path error detection equipment 25, the correction steering driving gear 26, and the auxiliary steering gear style 4 constitute a correction auxiliary control system.

[0012] The control function of perimeter map generation equipment 20, the parking path arithmetic unit 21, the front-wheel steering driving gear 22, the oil pressure braking driving gear 23, self-vehicle location presumption equipment 24, path error detection equipment 25, and the correction steering driving gear 26 is performed with a microcomputer software gestalt.

[0013] In addition, although detail explanation is omitted about the automatic gear M switched to the transit driving gears E which generate the transit driving force of a car, such as an engine and a motor, the control unit of those, Advance D, Retreat R, Neutrality N, and Parking P since it is well-known, these equipments control transit driving force and a change gear according to the parking location and parking path which were calculated with the parking path arithmetic unit 21.

[0014] Drawing 2 is a flow chart which shows actuation of the gestalt of the 1st operation. The perimeter [car] map generating routine shown in drawing 3 and drawing 4 in step 1 is performed, and the map of the perimeter of a car is created with perimeter map generation equipment 20. About creation of this perimeter [car] map, it mentions later. Next, the path planning location specification routine shown in drawing 7 - drawing 9 at step 2 is performed, the parking path arithmetic unit 21 determines a parking location based on a perimeter [car] map, and the optimal path to a parking location is set up. About a setup of this parking location and a parking path, it mentions later.

[0015] It asks for the front-wheel steering command according to a parking path at step 3, and drive control of the motor 5 for a front-wheel steering drive is carried out with the front-wheel steering driving gear 22. At continuing step 4, drive control of the oil pressure braking actuator 7 is carried out with the oil pressure braking driving gear 23, and a brake is taken off. According to a parking path, a change gear style is set as Advance D or Retreat R at coincidence with an automatic gear M, and a car is moved in accordance with a parking path. At step 5, while the yaw rate sensor 11 detects the yaw rate of a car, based on the yaw rate and wheel speed which detected wheel speed by the wheel speed sensors 10a-10d, and were detected at continuing step 6, a self-vehicle location is presumed with self-vehicle location presumption equipment 24. In step 7, it judges whether the presumed self-vehicle location was compared with the parking location, and the car arrived at the parking location. Actuation will be ended if a parking location is arrived at.

[0016] When the car has not arrived at a parking location, it progresses to step 8, and it judges [which set up with the presumed self-vehicle location and the parking path arithmetic unit 21] whether it set, and the point steering [end] was compared, the car set, and the point steering [end] was reached. If it sets and the point steering [end] is reached, it will progress to step 9, and drive control of the oil pressure braking actuator 7 is carried out with the oil pressure braking driving gear 23, and a brake is operated. If a car stops at step 10, the actuation mentioned above in quest of return and the front-wheel steering command which set and met the parking path in the point steering [end] to step 3 will be repeated.

[0017] When a car sets at step 8 and the point steering [end] is not reached, it progresses to step 11, and it checks whether a presumed self-vehicle location is on a parking path with path error detection equipment 25. A car is on a parking path, and when a path error is not detected, return and the actuation mentioned above are repeated to step 5.

[0018] When the presumed self-vehicle location is off the parking path, it progresses to step 12, and the target auxiliary steering angle according to the error of the presumed self-vehicle location to a parking path is calculated with the correction steering driving gear 26, and drive control of the rear wheel auxiliary steering gear style 4 is carried out according to a target auxiliary steering angle. Then, it returns to step 5, rear wheel correction steering is repeated, and it is made to return to a parking path gradually.

[0019] Next, the subroutine shown in drawing 3 and drawing 4 explains mapping actuation of the perimeter of a car. In addition, the subroutine shown in this drawing 3 and drawing 4 is performed by perimeter map generation equipment

20. Drawing 3 picturizes the perimeter environment of a car with a camera, and shows the actuation which processes an image pick-up image and detects the white line of a road surface. The ON state of a start switch is checked in step 21. If a start switch is in an ON state, it will progress to step 22, and the parameter i for switching four sets of CCD cameras 8a-8d is reset to 0. The camera change-over parameter i is incremented at continuing step 23, and the camera set as No. 1 is specified. In addition, Cameras 8a-8d support 1-4 of Parameter i in order.

[0020] In step 24, the perimeter environment of a car is picturized with the i-th camera. Differential processing of the picturized image is carried out, an edge is detected, and in order to emphasize the white line edge of a road surface, superposition of multiple times and a processing image is performed. The parameter showing the count of superposition of an image is set to N, at step 25, Parameter N is once reset to 0, Parameter N is incremented at continuing step 26, and superposition processing of a processing image is started. Differential processing of the image pick-up image is carried out at step 27, and an edge is piled up with the processing image of the same camera which detects and is memorized by Memory m at continuing step 28. When it checks whether only the count a of predetermined has performed superposition of an image at step 29 and a times of superposition is not completed, it returns to step 26 and the superposition of a processing image is repeated.

[0021] If the superposition of the processing image of the count a of predetermined is completed, it will progress to step 30 and the white line of a road surface will be extracted from the piled-up image. The white line showing a parking partition is also contained in these white lines. If it checks whether the white line extract has been completed and has not completed at step 31, to step 23, return and the camera change-over parameter i are incremented, and the image pick-up with a camera, an image processing, next superposition processing, and a next white line extract are performed.

[0022] If white line extract actuation is completed, it will progress to step 32, and coordinate transformation is carried out to the planar map system of coordinates which make a self-car a zero from the system of coordinates of an image pick-up image with a camera, and the white line map centering on a self-car is created for every camera at continuing step 33. For example, the white line map on the left-hand side of the car front is created with the image picturized by CCD camera 8a. In step 34, the white line map created for every camera is unified centering on a self-car, and a gap of a coordinate is corrected. At step 35, the created white line map is written in memory, and is memorized.

[0023] Drawing 4 shows the actuation which detects an obstruction with a laser radar. In step 41, the parameter i for switching four sets of the radar radars 9a-9d is reset to 0, and Parameter i is incremented at continuing step 42. In addition, laser radars 9a-9d support 1-4 of Parameter i in order.

[0024] In step 43, the i-th laser radar detects an obstruction. In order to detect an obstruction correctly, superposition of multiple times and detection data is performed. The parameter showing the count of superposition of an image is set to N, at step 44, Parameter N is once reset to 0, Parameter N is incremented at continuing step 45, and the superposition of detection data is started. At step 46, the ranging data based on a laser radar are changed into function L=f (theta) of the scan angle theta of a laser radar. At step 47, it piles up with the ranging data of the same laser radar memorized by memory.

[0025] When it checks whether only the count a of predetermined has performed superposition of ranging data at step 48 and a times of superposition is not completed, it returns to step 45 and the superposition of an image pick-up and ranging data is repeated. If superposition of the count a of predetermined is performed, it will progress to step 49 and an obstruction map will be created for every laser radar. If it checks whether the obstruction map by all the laser radars 9a-9d has been created and is not created at step 50, it returns to step 42 and Parameter i is incremented, and an obstruction map is created based on the ranging data of the following laser radar.

[0026] If creation of the obstruction map by all the laser radars 9a-9d is completed, it will progress to step 51, and the obstruction map which unifies the obstruction map created for every laser radar, and makes a self-car a zero is created. In step 52, the white line map which is already created and is memorized is read, a white line map and an obstruction map are unified at step 53, and the map of the perimeter of a car is created.

[0027] Next, drawing 5 - drawing 9 explain the setting approach of a parking location and a parking path. Drawing 5 is drawing showing a parking location and a parking path in case the direction of the car at the time of parking turns car anterior part in the direction of a road and carries out juxtaposition parking. Here, Car X shall be parked to the parking location C of the white line frame L in the parking lot shown in drawing. Radii calcium are radii of the minimum radius of gyration minR in the revolution inner ring of spiral wound gasket of Car X, and Radii Cb are radii of a radius which added Tread Wt to the minimum radius of gyration minR in the outer ring of spiral wound gasket of Car X, i.e., the minimum radius of gyration in an inner ring of spiral wound gasket. Radii calcium touch the production of the parking frame La, and Radii Cb touch the advance straight line Lb which shows the current travelling direction of Car X. the case where Car X is moved to the parking location C from from outside the field S decided by Radii calcium -- at least 2 times or more -- it is necessary to set and to perform end steering

[0028] The path which the car X which has a forward left ring in an A point cuts back, and advances to the parking location C by one steering goes straight on along with the advance straight line Lb from an A point, by the **** start point P0 which the advance straight line Lb and Radii Cb touch, full **** of it is carried out, it rotates clockwise on the right, and is stopped in [1st attainment target / P1] that Radii calcium and Radii Cb touch. It is the path which retreats carrying out full **** and rotating anticlockwise on the left at this 1st attainment target point P1, **** to neutrality in [D] that Radii calcium touch the production of the parking frame La, retreats straightly as it is, and advances to the parking location C.

[0029] Drawing 6 is drawing showing (right-hand side [Lc / in drawing]), a parking location, and a parking path when the initial valve position of a car is separated from the inlet-port D point of the parking location C beyond the minimum radius of gyration minR. Radii calcium, Cd, and Ce are radii of the minimum radius of gyration minR in the revolution inner ring of spiral wound gasket of Car X, and Radii Cb and Cc are radii of a radius which added Tread Wt to the minimum radius of gyration minR in a revolution outer ring of spiral wound gasket, i.e., the minimum radius of gyration of a revolution inner ring of spiral wound gasket.

[0030] this case -- setting -- as -- steering -- there are at least three kinds of parking paths which advance to the parking location C by one cut steering. The 1st parking path goes straight on along with the advance straight line Lb from a B point, and is stopped at 1st attainment target P1a to which the advance straight line Lb touches Radii Cc. It steers only in ****** by this 1st attainment target point P1a, and moves forward to the point G that hold steering only in ****** and Radii Cc touch the production of the parking frame La. It is the path which **** to neutrality, carries out rectilinear-propagation retreat by these G points, and advances to the parking location C.

[0031] The 2nd parking path goes straight on along with the advance straight line Lb from a B point, and is stopped at 1st attainment target point P1b to which the advance straight line Lb touches Radii Cd. It is the path which retreats by clockwise rotation, **** to neutrality, carries out [full **** is carried out by this 1st attainment target point P1b on the left, and] rectilinear-propagation retreat in [E] that Radii Cd touch the production of the parking frame La, and advances to the parking location C.

[0032] Like the path shown in drawing 5 , the 3rd parking path goes straight on along with the advance straight line Lb from a B point, on the right, full **** of it is carried out, it rotates clockwise by the **** start point P0 which the advance straight line Lb and Radii Cb touch, and is stopped at 1st attainment target point P1c which Radii Cb and Radii Ce touch. It is the path which carries out full **** by this 1st attainment target point P1c on the left, retreats by clockwise rotation, **** to neutrality in [F] that Radii Ce touch the production of the parking frame La, retreats straightly as it is, and advances to the parking location C.

[0033] Thus, when two or more paths which can be parked by one cut steering exist, the operation idea of crew's past is taken into consideration to the performance index which makes min amounts of control, such as a count of a cut, and a count of steering, the performance index which makes mileage min, the performance index which makes the shortest time amount which parking takes, it shifts to it, and that parking path is determined as it.

[0034] Drawing 7 - drawing 9 are flow charts which show the configuration routine of a parking location and a parking path. In steps 61-65 of drawing 7 , the location which can be parked is pinpointed and comprehension of an operator is obtained. That is, the perimeter map of the car created with perimeter map generation equipment 20 at step 61, i.e., the white line of the perimeter of a car and the map of an obstruction, is read. Sequential collating of the template which expresses full [of a car / the overall length and full] in continuing step 62 as the field which is expressed with the white line on a map, and which can be parked is carried out, and the location at which a car can be parked is extracted. The parking location which pinpointed the parking location nearest to a car at step 63 out of the location which can be parked, and was pinpointed on the display at step 64 is displayed. An operator inputs with an input unit whether the display of this parking location is seen and understood. At step 65, it checks whether comprehension of the parking location by the operator has been obtained, and when comprehension is not obtained, return and the location of a degree which can be parked are pinpointed to step 62.

[0035] If comprehension of the operator to the proposed parking location is obtained, it will progress to step 66, and the last change candidate point is extracted. This last change candidate point is a point which a change for a car to go into a parking location completes, and D, E and F which change with parking paths, and G points correspond in the example shown in drawing 5 and drawing 6 . At step 67, the locus group C1 of the radii of the minimum turning radius which touches the production of a white line frame is extracted. In the example shown in drawing 5 and drawing 6 , the radii calcium and Cd of the minimum turning radius minR which touches the production of the white line frame La are equivalent to the locus group C1. In step 68, it checks whether the radii which touch the advance straight line of a car are in the locus group C1. There are no radii which correspond in the example of drawing 5 , and Radii Cd correspond in the example of drawing 6 .

[0036] When there are no radii equivalent to Cd of drawing 6 which touches with the advance straight line of a car into

the locus group C1 of the radii which touch the production of a parking frame, as shown in drawing 5 , when a car is close to a parking location, it moves forward to 1st attainment target point P1a along with an advance straight line, and the parking path which **** only once on the left by 1st attainment target point P1a, and advances to a parking location will not exist. In this case, it must once circle and cut back to a parking location and the opposite side, and must advance into a parking location. On the other hand, when the radii which touch the advance straight line of a car are in the locus group C1 of the radii which touch the production of the parking frame La, the parking path which passes along Radii Cd from 1st attainment target point P1b as shown in drawing 6 exists.

[0037] When there are no radii which touch with the advance straight line of a car into the locus group C1 of the radii which touch the production of the parking frame La, it is step 69, and the locus group C2 of the outer-ring-of-spiral-wound-gasket minimum turning radius which touches the advance straight line Lb of a car is extracted. The radii Cb shown in drawing 5 and the radii Cc shown in drawing 6 are contained in the locus group C2. It checks whether there are some which touch the radii contained in the radii contained in the locus group C2 at step 70 at the locus group C1. When the radii which touch the advance straight line of a car, and the radii which touch the production of a parking frame touch, the parking path which circles and cuts back to a parking location and the opposite side, and advances into a parking frame exists, and it progresses to step 81 in that case. On the other hand, when there are such no radii, it progresses to step 91 and searches for other parking paths.

[0038] The 1st attainment target point is specified in step 81 of drawing 8 . In the example shown in drawing 6 , when P1b shown in drawing 6 when point P1a, P1b, and P1c correspond and it shifts from step 68 is specified as a 1st attainment target point and shifts from step 70, P1c shown in P1 shown in drawing 5 or drawing 6 is specified. At step 82, the path m1 to the 1st attainment target point is formed. Furthermore at step 83, the **** start point P0 is specified. In the example shown in drawing 5 and drawing 6 , a point P0 is equivalent to a **** start point.

[0039] In step 91 of drawing 9 , it is the radii which touch the production of a parking frame, and the advance straight line of a car, and the radii more than a minimum turning radius minR are calculated. At step 92, if there are radii of the above-mentioned conditions, it will progress to step 81, and if there is nothing, it will progress to step 93. At step 93, a parking location is changed and the parking location of a degree is proposed.

[0040] Drawing 10 shows the example of path correction by rear wheel correction steering of the gestalt of the 1st operation. Suppose that steering of target steering angle thetaf was performed by the main control system, and it left in accordance with the target parking path shown as a continuous line by it at a steering point (Xk-1, Yk-1). However, an inclination and humidity are in a road surface, and it strays off a target parking path, and suppose that it ran the real transit path top shown with a broken line, and the point (Xc, Yc) was arrived at.

[0041] The error with the target parking path in a point (Xc, Yc) is [Equation 1]. They are deltaX=Xk-Xc and deltaY=Yk-Yc. Target auxiliary steering angle thetar is computed by the degree type from this error.

[Equation 2] thetar=K1, deltaX+K2, anddeltaY -- here, correction steering gain [as opposed to X lateral deviation in K1] and K2 are the correction steering gain over Y lateral deviation.

[0042] From a point (Xc, Yc), the front-wheel steering angle by the main control system is considered as as [thetaf], and performs rear wheel auxiliary steering of target auxiliary steering angle thetar according to a correction auxiliary control system. Thereby, a real transit path approaches the original target parking path gradually, goes, and returns to a target parking path near a point (Xk+1, Yk+1).

[0043] Thus, the present location of a car is detected, the amount of blanks from the parking path of a its present location is detected, and the rear wheel auxiliary steering gear style was made to perform correction steering according to the amount of blanks. By this, whenever it strays off a parking path, it is not necessary to redo the path operation from the location, and it is not necessary to correct a path. Since the main steering in alignment with the original parking path is left as it is and a rear wheel auxiliary steering gear style performs correction steering according to the amount of blanks from a parking path, it can return to the parking path of the beginning [be / you / Sumiya], the operation of the parking path which time amount requires is omitted, and parking can be ended correctly early. Moreover, since the rear wheel auxiliary steering gear style was made to perform correction steering when it strayed off a parking path, the rear wheel steering gear style used for the usual four-flower steering can be used, and it is not necessary to prepare an auxiliary steering gear style separately.

[0044] In the configuration of the gestalt of the above operation [1st] CCD cameras 8a-8d, Laser radars 9a-9d and perimeter map generation equipment 20 a perimeter environmental detection means The front-wheel steering driving gear 22 and the oil pressure braking driving gear 23 an operation means an automatic parking control means [the parking path arithmetic unit 21] Path error detection equipment 25 separates [self-vehicle location presumption equipment 24] from a current District Public Prosecutor's Office appearance means, and the correction steering driving gear 26 and the rear wheel auxiliary steering gear style 4 constitute an auxiliary steersman stage for an amount detection means, respectively.

[0045] - Gestalt of implementation of the 2nd of invention - With the gestalt of the 1st operation, when it strayed off the target parking path, the example which performs correction steering by the rear wheel auxiliary steering gear style was shown, but the front-wheel auxiliary steering gear style which performs auxiliary steering of a front wheel is prepared, and when it separates from a target parking path, the 2nd gestalt of operation carry out correction steering by the front-wheel auxiliary steering gear style is explained.
[0046] The 2nd configuration of the gestalt of operation is shown in drawing 11 . In addition, the same sign is attached to the configuration equipment shown in drawing 1 , and the same device, and it explains focusing on difference. The front-wheel auxiliary steering gear style 31 is driven with driving gears, such as electric ******, and performs auxiliary steering of front wheels 1a and 1b.
[0047] Drawing 12 shows the detail of the front-wheel auxiliary steering gear style 31. The steering column shaft 102 by which a rotation drive is carried out with a steering wheel 101 is connected with the steering rack unit 104 fixed to a suspension member 103 through the motor 5 for a front-wheel steering drive mentioned above, and front wheels 1a and 1b are steered by the rotation driving force of a steering wheel 101 or the motor 5 for a front-wheel steering drive. A suspension member 103 is attached in a car body 107 through the member bush 105,106. The front-wheel steering auxiliary actuator 108 is being fixed to the car body 107, and the rod 108a is connected with the suspension member 103.
[0048] If the front-wheel steering auxiliary actuator 108 operates in the direction of an illustration arrow head with the correction steering driving gear 26, since the suspension member 103 is attached through the soft member bush 105,106 to the car body 107, a suspension member 103 moves in the same direction as the actuation direction of the front-wheel steering auxiliary actuator 108 with the steering rack unit 104, front wheels 1a and 1b carry out minute ****, and correction steering is performed.
[0049] In addition, in step 12 of actuation of the gestalt of the 1st operation shown in drawing 2 , except for the point of performing front-wheel correction steering by the above-mentioned front-wheel steering gear style 31 instead of rear wheel correction steering, actuation of the gestalt of the 2nd operation is the same and omits illustration and its explanation.
[0050] Thus, when it strayed off a parking path, the front-wheel auxiliary steering gear style which performs auxiliary steering of a front wheel was made to perform correction steering. By this, whenever it strays off a parking path, it is not necessary to redo the path operation from the location, and it is not necessary to correct a path. Since the main steering in alignment with the original parking path is left as it is and a front-wheel auxiliary steering gear style performs correction steering according to the amount of blanks from a parking path, it can return to the parking path of the beginning [be / you / Sumiya], the operation of the parking path which time amount requires is omitted, and parking can be ended correctly early.
[0051] In the configuration of the gestalt of the above operation [2nd] CCD cameras 8a-8d, Laser radars 9a-9d and perimeter map generation equipment 20 a perimeter environmental detection means The front-wheel steering driving gear 22 and the oil pressure braking driving gear 23 an operation means an automatic parking control means [the parking path arithmetic unit 21] Path error detection equipment 25 separates [self-vehicle location presumption equipment 24] from a current District Public Prosecutor's Office appearance means, and the correction steering driving gear 26 and the front-wheel auxiliary steering gear style 31 constitute an auxiliary steersman stage for an amount detection means, respectively.
[0052] - Gestalt of implementation of the 3rd of invention - Although the gestalt of the 1st mentioned above and the 2nd operation showed the example which prepares an auxiliary steering gear style in a front wheel or a rear wheel, and corrects deviation from a parking path, right-and-left independence of the rear wheel is achieved, braking is made possible, and by changing the damping force of a rear wheel on either side explains the 3rd gestalt of operation carry out correction steering.
[0053] The 3rd configuration of the gestalt of operation is shown in drawing 13 . In addition, the same sign is attached to the configuration equipment shown in drawing 1 , and the same device, and it explains focusing on difference. The left wheel damping device 32 drives brake caliper 6of left rear ring 3a a, and the right wheel damping device 33 drives brake caliper 6of right rear ring 3b b. The oil pressure braking control unit 34 controls independently the left wheel damping device 32 and the right wheel damping device 33, and controls separately the brake force of left rear ring 3a and right rear ring 3b.
[0054] When a braking command is taken out from the parking path arithmetic unit 21 or the correction steering driving gear 26, the oil pressure braking control device 34 controls the left wheel damping device 32 and the right wheel damping device 33 by the same brake force to coincidence, and makes the right-and-left rear wheels 3a and 3b generate the same brake force in coincidence.
[0055] If a leftward correction steering command is taken out from the correction steering driving gear 26, the oil

pressure braking control device 34 will operate the left wheel damping device 32, will make left rear ring 3a generate a brake force, and will rotate a car anticlockwise. On the other hand, if a rightward correction steering command is taken out from the correction steering driving gear 26, the oil pressure braking control device 34 will operate the right wheel damping device 33, will make right rear ring 3b generate a brake force, and will rotate a car clockwise.
[0056] In addition, in step 12 of actuation of the gestalt of the 1st operation shown in drawing 2 , except for the point of generating a brake force instead of rear wheel correction steering independently of the right-and-left rear wheels 3a and 3b by the damping devices 32 and 33 and the oil pressure braking control device 34 of those of the right-and-left independence mentioned above, and performing correction steering, actuation of the gestalt of the 3rd operation is the same and omits illustration and its explanation.
[0057] Thus, since a left rear ring brake mechanism and a right rear ring brake mechanism are controlled independently and it was made to perform correction steering Whenever it strays off a parking path, it is not necessary to redo the path operation from the location, and it is not necessary to correct a path. Since the main steering in alignment with the original parking path is left as it is and a rear wheel brake mechanism on either side performs correction steering according to the amount of blanks from a parking path, it can return to the parking path of the beginning [be / you / Sumiya], the operation of the parking path which time amount requires is omitted, and parking can be ended correctly early.
[0058] In the configuration of the gestalt of the above operation [3rd] CCD cameras 8a-8d, Laser radars 9a-9d and perimeter map generation equipment 20 a perimeter environmental detection means The front-wheel steering driving gear 22 and the oil pressure braking control unit 34 an operation means an automatic parking control means [the parking path arithmetic unit 21] Path error detection equipment 25 separates [self-vehicle location presumption equipment 24] from a current District Public Prosecutor's Office appearance means, and the correction steering driving gear 26, the oil pressure braking control unit 34, the left wheel damping device 32, and the right wheel damping device 33 constitute an auxiliary steersman stage for an amount detection means, respectively.
[0059] In addition, although the gestalt of implementation of the above 3rd showed the example which controls independently a rear wheel brake mechanism on either side, and performs correction steering, a front-wheel brake mechanism on either side is controlled independently, and it may be made to perform correction steering.
[0060] - Modification of the gestalt of implementation of invention - with the gestalt of operation mentioned above While a front-wheel steering gear style performs the main steering, an auxiliary steering gear style is prepared in a rear wheel or a front wheel. Although the example which performs correction steering by the auxiliary steering gear style, or installs the damping device of a rear wheel in right-and-left independence, controls the brake force of a rear wheel to right-and-left independence, and is performed in correction steering was shown when it deviated from a parking path, you may make a front-wheel steering gear style serve a double purpose to the main steering and correction auxiliary steering. In this case, you may steer with the amounts of control which superimposed correction auxiliary amounts of control on the main amounts of control, and it may be made to perform the main steering and correction auxiliary steering by turns by time sharing. However, when full **** of the front wheel is carried out by the main steering, the point that correction auxiliary steering can be performed only to an one direction must be taken into consideration.
[0061] Drawing 14 shows the configuration in the case of using a front-wheel steering gear style also [steering / the main steering and / correction auxiliary]. In addition, the same sign is attached to the same configuration equipment as the gestalt of the 1st operation shown in drawing 1 , and it explains focusing on difference. The front-wheel steering driving gear 22 performs correction auxiliary steering by the motor 5 for a front-wheel steering drive according to the correction steering control output from the correction steering driving gear 26 while performing the main steering by the motor 5 for a front-wheel steering drive according to the main steering control output from the parking path arithmetic unit 21.

[Translation done.]

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the automatic parking equipment to which a parking path is calculated and a car is automatically moved to a parking location.
[0002]
[Description of the Prior Art] The automatic parking equipment to which the induction path to a parking location is calculated and a car is automatically moved to a parking location is known (for example, refer to JP,6-75629,A). In order to move a car in accordance with a target parking path, according to a car location, steering, driving force, and damping force are controlled by this kind of equipment.
[0003]
[Problem(s) to be Solved by the Invention] By the way, it may stray off a target parking path by the inclination of the road surface of a parking path, change of the tire radius by the car loading object, etc. In such a case, if it strays off a target parking path, a path operation will be redone, and in accordance with the newly calculated target parking path, steering, driving force, and damping force are controlled by conventional automatic parking equipment. However, with conventional automatic parking equipment, when a path operation is redone whenever it strays off a target parking path since the path operation to a parking location takes time amount, there is a problem that the time amount which automatic parking takes will become long.
[0004] The purpose of this invention is to offer the automatic parking equipment which corrects deviation from a target parking path whether you are Sumiya.
[0005]
[Means for Solving the Problem]
(1) Invention of claim 1 is applied to automatic parking equipment equipped with a perimeter environmental detection means detect the perimeter environment of a car, an operation means calculate the path to a parking location and its parking location based on the perimeter environment of a car, and the automatic parking control means that controls the transit driving gear of a car, a brake mechanism, the main steering-gear style, and an automatic transmission, and move a car to a parking location automatically in accordance with a parking path. And it has a current District Public Prosecutor's Office appearance means to detect the present location of a car, an amount detection means of blanks to detect the amount of blanks from the parking path of the present location of a car, and the auxiliary steersman stage that performs correction steering according to said amount of blanks.
(2) The automatic parking equipment of claim 2 is made to perform correction steering by the rear wheel auxiliary steering gear style to which an auxiliary steersman stage performs auxiliary steering of a rear wheel.
(3) The automatic parking equipment of claim 3 is made to perform correction steering by the front-wheel auxiliary steering gear style to which an auxiliary steersman stage performs auxiliary steering of a front wheel.
(4) An auxiliary steersman stage is equipped with a left rear ring brake mechanism and a right rear ring brake mechanism, controls independently a left rear ring brake mechanism and a right rear ring brake mechanism, and the automatic parking equipment of claim 4 is made to perform correction steering.
(5) An auxiliary steersman stage is equipped with a forward left ring brake mechanism and a forward right ring brake mechanism, controls independently a forward left ring brake mechanism and a forward right ring brake mechanism, and the automatic parking equipment of claim 5 is made to perform correction steering.
(6) As for the automatic parking equipment of claim 6, an auxiliary steersman stage is made to perform correction steering by the front-wheel main steering gear style according to said amount of blanks.
(7) Invention of claim 7 detects the perimeter environment of a car, and calculates a parking location and a parking path. The transit driving gear, the brake mechanism, the main steering gear style, and automatic transmission of a car

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CLAIMS

[Claim(s)]
[Claim 1] Automatic parking equipment equipped with a perimeter environmental detection means characterized by to provide the following detect the perimeter environment of a car, an operation means calculate the path to a parking location and its parking location based on the perimeter environment of a car, and the automatic parking control means which control the transit driving gear of a car, a brake mechanism, the main steering-gear style, and an automatic transmission, and move a car automatically to a parking location in accordance with a parking path A current District Public Prosecutor's Office appearance means to detect the present location of a car An amount detection means of blanks to detect the amount of blanks from the parking path of the present location of a car The auxiliary steersman stage which performs correction steering according to said amount of blanks
[Claim 2] It is automatic parking equipment characterized by performing correction steering by the rear wheel auxiliary steering gear style to which said auxiliary steersman stage performs auxiliary steering of a rear wheel in automatic parking equipment according to claim 1.
[Claim 3] It is automatic parking equipment characterized by performing correction steering by the front-wheel auxiliary steering gear style to which said auxiliary steersman stage performs auxiliary steering of a front wheel in automatic parking equipment according to claim 1.
[Claim 4] It is automatic parking equipment characterized by equipping said auxiliary steersman stage with a left rear ring brake mechanism and a right rear ring brake mechanism in automatic parking equipment according to claim 1, controlling independently said left rear ring brake mechanism and said right rear ring brake mechanism, and performing correction steering.
[Claim 5] It is automatic parking equipment characterized by equipping said auxiliary steersman stage with a forward left ring brake mechanism and a forward right ring brake mechanism in automatic parking equipment according to claim 1, controlling independently said forward left ring brake mechanism and said forward right ring brake mechanism, and performing correction steering.
[Claim 6] It is automatic parking equipment characterized by said auxiliary steersman stage performing correction steering in automatic parking equipment according to claim 1 according to said amount of blanks by the front-wheel main steering gear style.
[Claim 7] In the automatic parking equipment which detects the perimeter environment of a car, calculates a parking location and a parking path, controls the transit driving gear, the brake mechanism, the main steering gear style, and automatic transmission of a car, and moves a car to a parking location automatically in accordance with a parking path Automatic parking equipment characterized by detecting the present location of a car, detecting the amount of blanks from the parking path of a its present location, and performing correction steering by the auxiliary steering gear style according to said amount of blanks.

[Translation done.]

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is drawing showing the 1st configuration of the gestalt of operation.
[Drawing 2] It is the flow chart which shows actuation of the gestalt of the 1st operation.
[Drawing 3] It is the flow chart which shows a perimeter [car] map generating routine.
[Drawing 4] It is the flow chart following drawing 3 which shows a car map generating routine.
[Drawing 5] It is drawing showing a parking path in case the direction of the car at the time of parking turns car anterior part in the direction of a road and carries out juxtaposition parking.
[Drawing 6] It is drawing showing the parking path at the time of stopping in the distance from a parking location in the parking lot shown in drawing 5 .
[Drawing 7] It is the flow chart which shows the configuration routine of a parking location and a parking path.
[Drawing 8] It is the flow chart following drawing 7 which shows the configuration routine of a parking location and a parking path.
[Drawing 9] It is the flow chart following drawing 8 which shows the configuration routine of a parking location and a parking path.
[Drawing 10] It is drawing showing the example of path correction by rear wheel correction steering of the gestalt of the 1st operation.
[Drawing 11] It is drawing showing the 2nd configuration of the gestalt of operation.
[Drawing 12] It is drawing showing a front-wheel auxiliary steering gear style.
[Drawing 13] It is drawing showing the 3rd configuration of the gestalt of operation.
[Drawing 14] It is drawing showing the configuration of the modification of the gestalt of operation of invention.
[Description of Notations]
1a, 1b Front wheel
2 Front-Wheel Steering Gear Style
3a, 3b Rear wheel
4 Rear Wheel Auxiliary Steering Gear Style
5 Motor for Front-Wheel Steering Drive
6a, 6b Brake caliper
7 Oil Pressure Braking Actuator
8a-8d CCD camera
9a-9d Laser radar
10a-10d Wheel speed sensor
11 Yaw Rate Sensor
20 Perimeter Map Generation Equipment
21 Parking Path Arithmetic Unit
22 Front-Wheel Steering Driving Gear
23 Oil Pressure Braking Driving Gear
24 Self-Vehicle Location Presumption Equipment
25 Path Error Detection Equipment
26 Correction Steering Driving Gear
31 Front-Wheel Steering Gear Style
32 Left Wheel Damping Device
33 Right Wheel Damping Device
34 Oil Pressure Braking Control Unit

101 Steering Wheel
102 Steering Column Shaft
103 Suspension Member
104 Steering Rack Unit
105,106 Member bush
107 Car Body
108 Front-Wheel Steering Actuator

[Translation done.]

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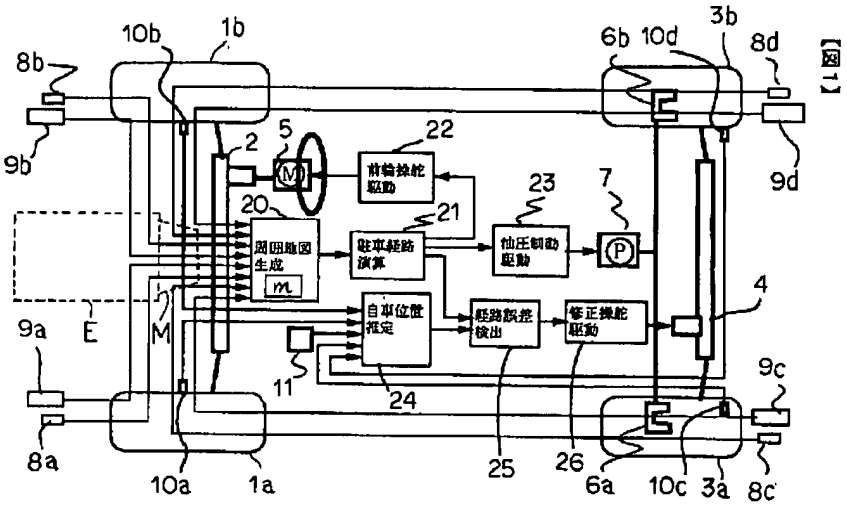
DRAWINGS

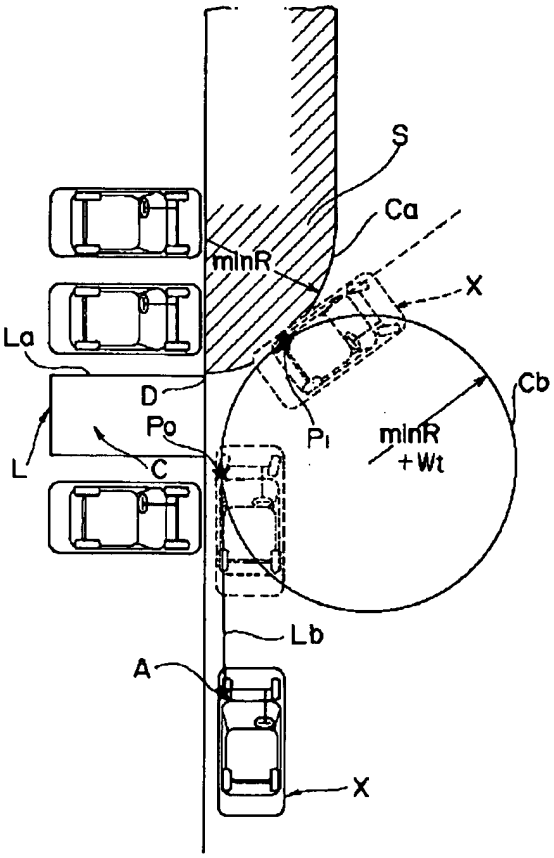
[Drawing 1]



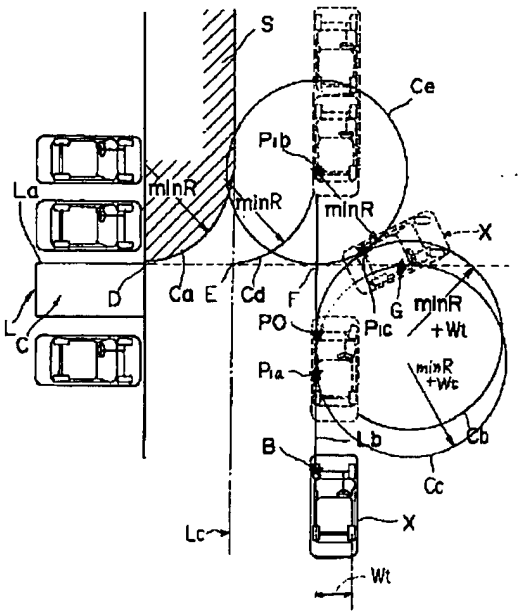
【図1】

[Drawing 5]

【図５】

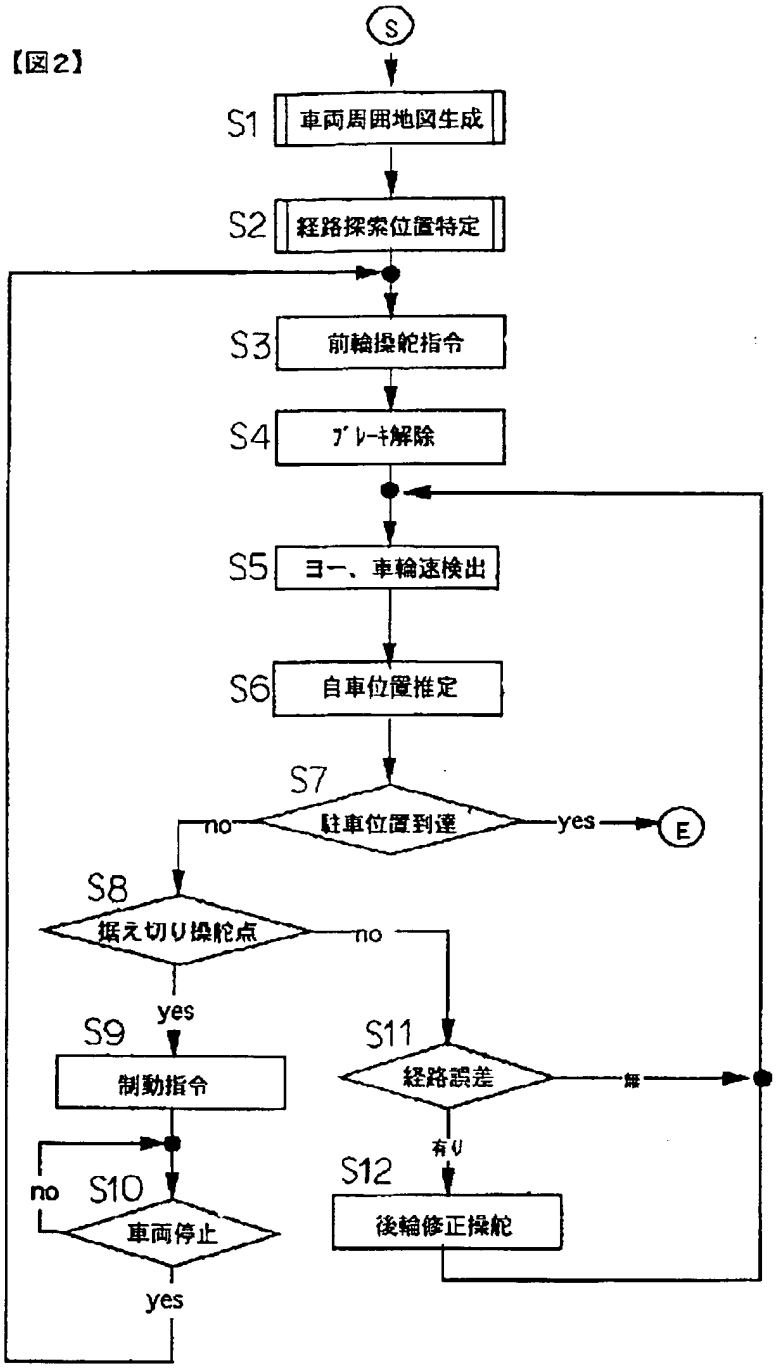


[Drawing 6]
【図 6】



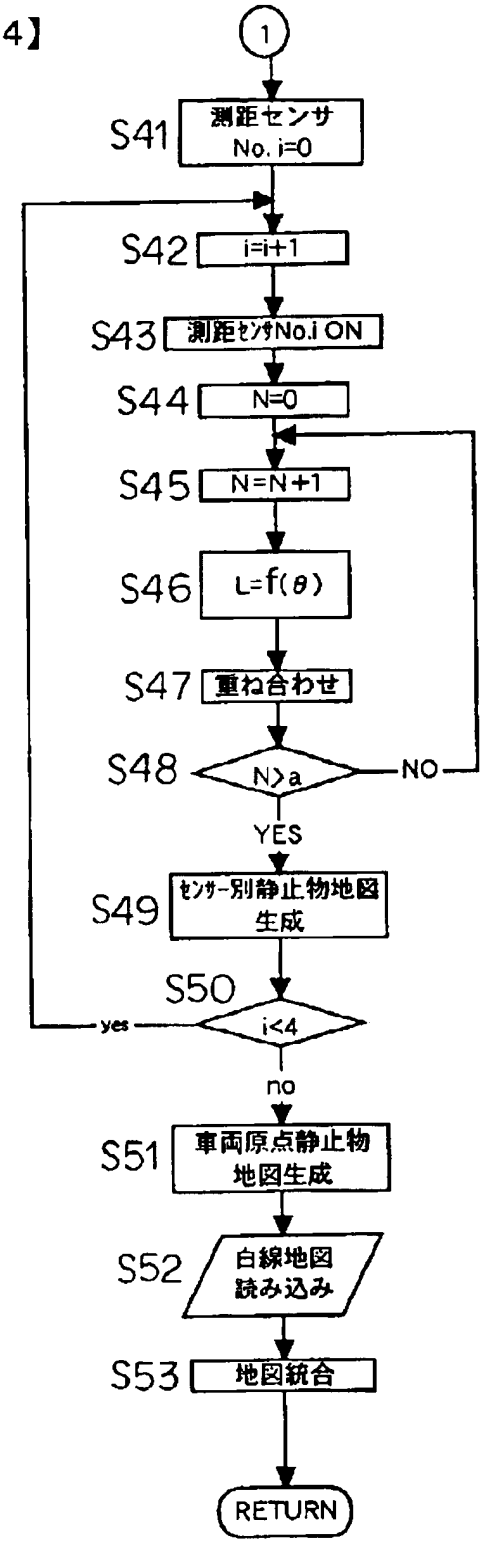
[Drawing 2]

【図2】


S
S1
車両周囲地図生成
S2
経路探索位置特定
S3
前輪操舵指令
S4
ブレーキ解除
S5
ヨー、車輪速検出
S6
自車位置推定
S7
駐車位置到達
no
yes
E
S8
据え切り操舵点
no
yes
S9
制動指令
S11
経路誤差
無
有り
S12
後輪修正操舵
no
S10
車両停止
yes

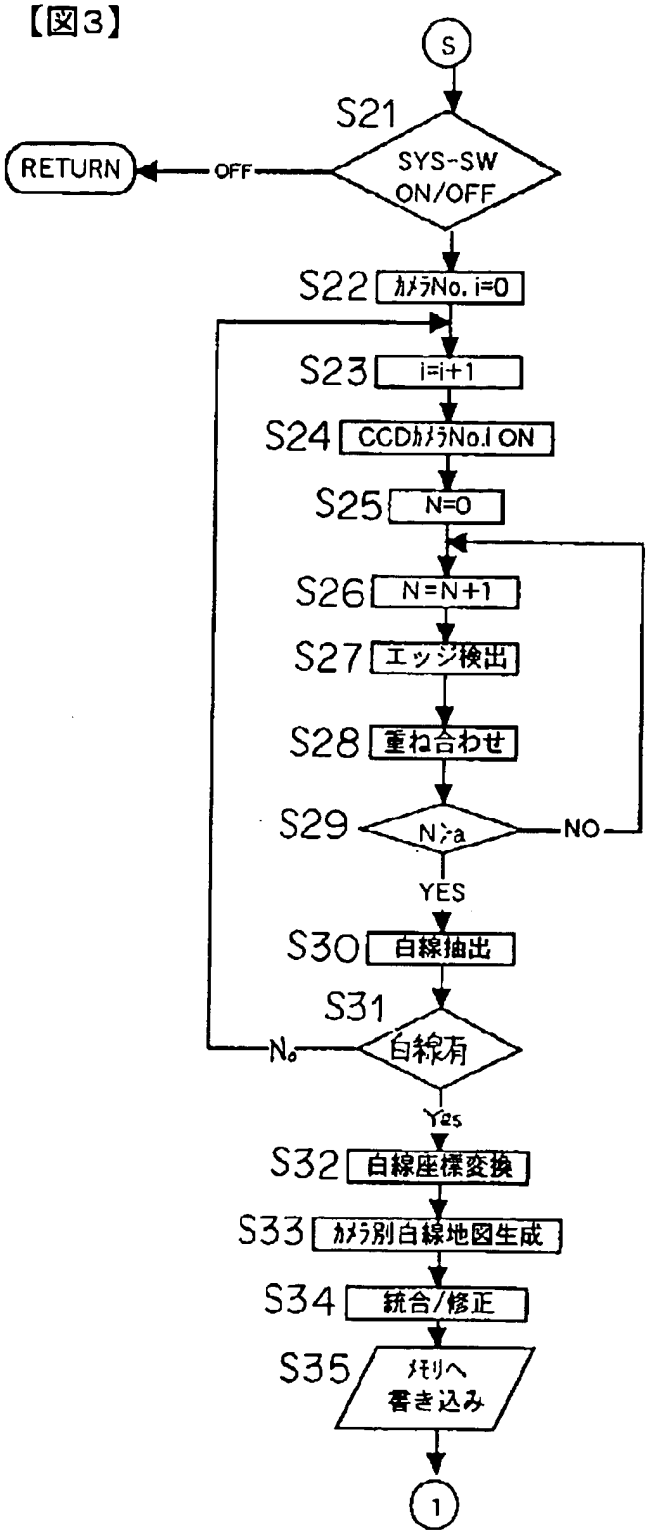
[Drawing 4]

【図4】


1
S41
測距センサ No. i=0
S42
i=i+1
S43
測距ｾﾝｻNo.i ON
S44
N=0
S45
N=N+1
S46
L=f(θ)
S47
重ね合わせ
S48
N>a
NO
YES
S49
ｾﾝｻｰ別静止物地図生成
S50
i<4
yes
no
S51
車両原点静止物地図生成
S52
白線地図読み込み
S53
地図統合
RETURN

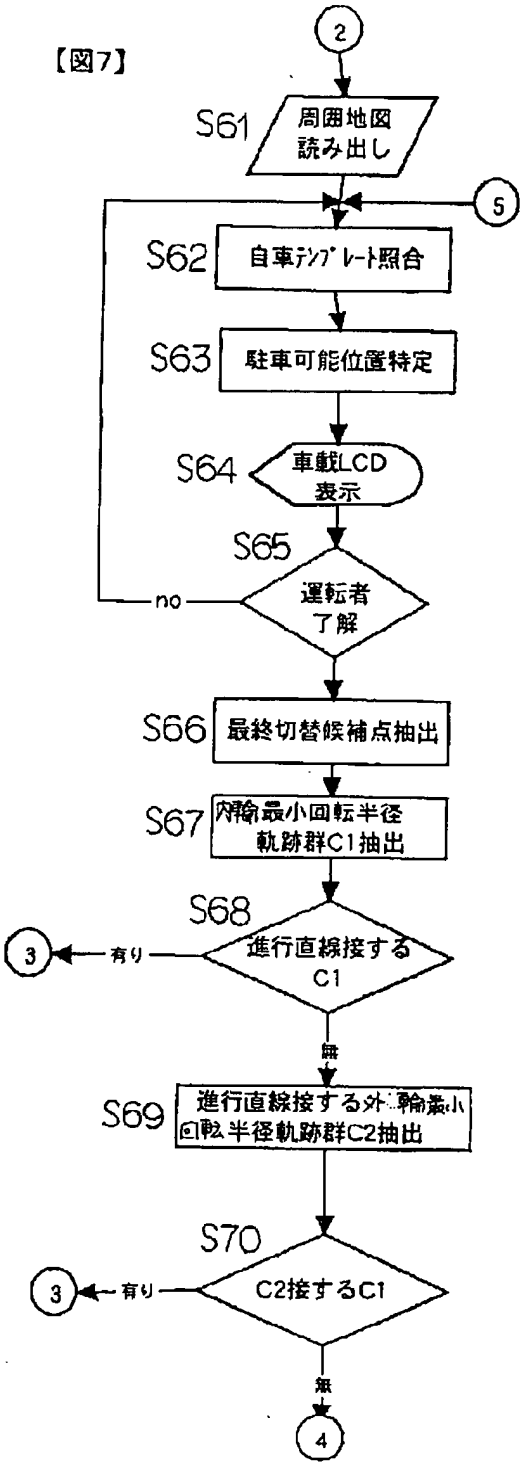
[Drawing 3]

【図3】


S
S21
SYS-SW ON/OFF
OFF
RETURN
S22 カメラNo. i=0
S23 i=i+1
S24 CCDカメラNo.i ON
S25 N=0
S26 N=N+1
S27 エッジ検出
S28 重ね合わせ
S29 N>a
NO
YES
S30 白線抽出
S31 白線有
No
Yes
S32 白線座標変換
S33 カメラ別白線地図生成
S34 統合/修正
S35 メモリへ書き込み
1

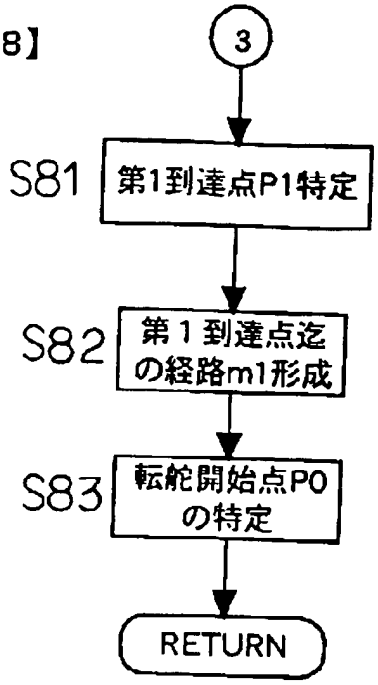
[Drawing 7]

【図7】


2
S61
周囲地図
読み出し
5
S62
自車ﾃﾝﾌﾟﾚｰﾄ照合
S63
駐車可能位置特定
S64
車載LCD
表示
S65
no
運転者
了解
S66
最終切替候補点抽出
S67
内輪最小回転半径
軌跡群C1抽出
S68
3
有り
進行直線接する
C1
無
S69
進行直線接する外輪最小
回転半径軌跡群C2抽出
S70
3
有り
C2接するC1
無
4

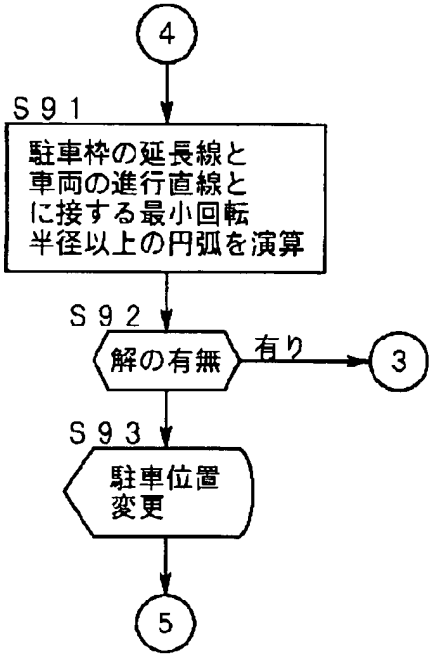
[Drawing 8]

【図8】

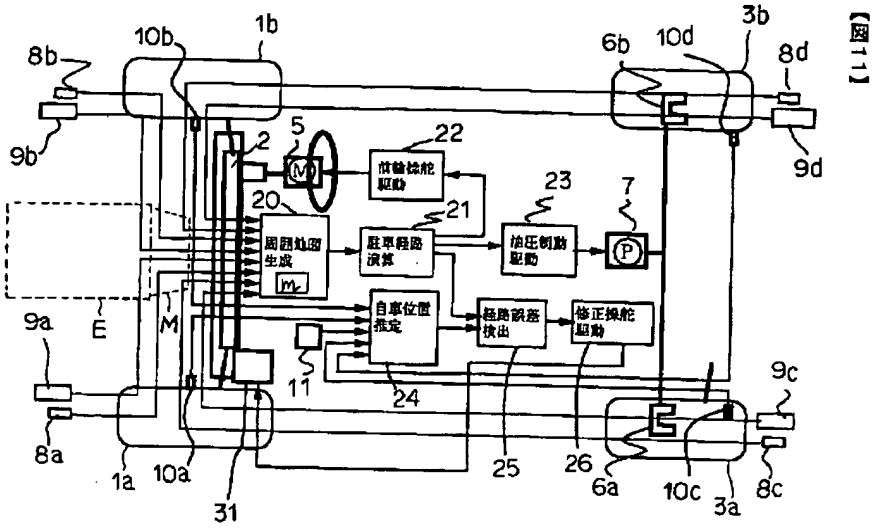


[Drawing 9]

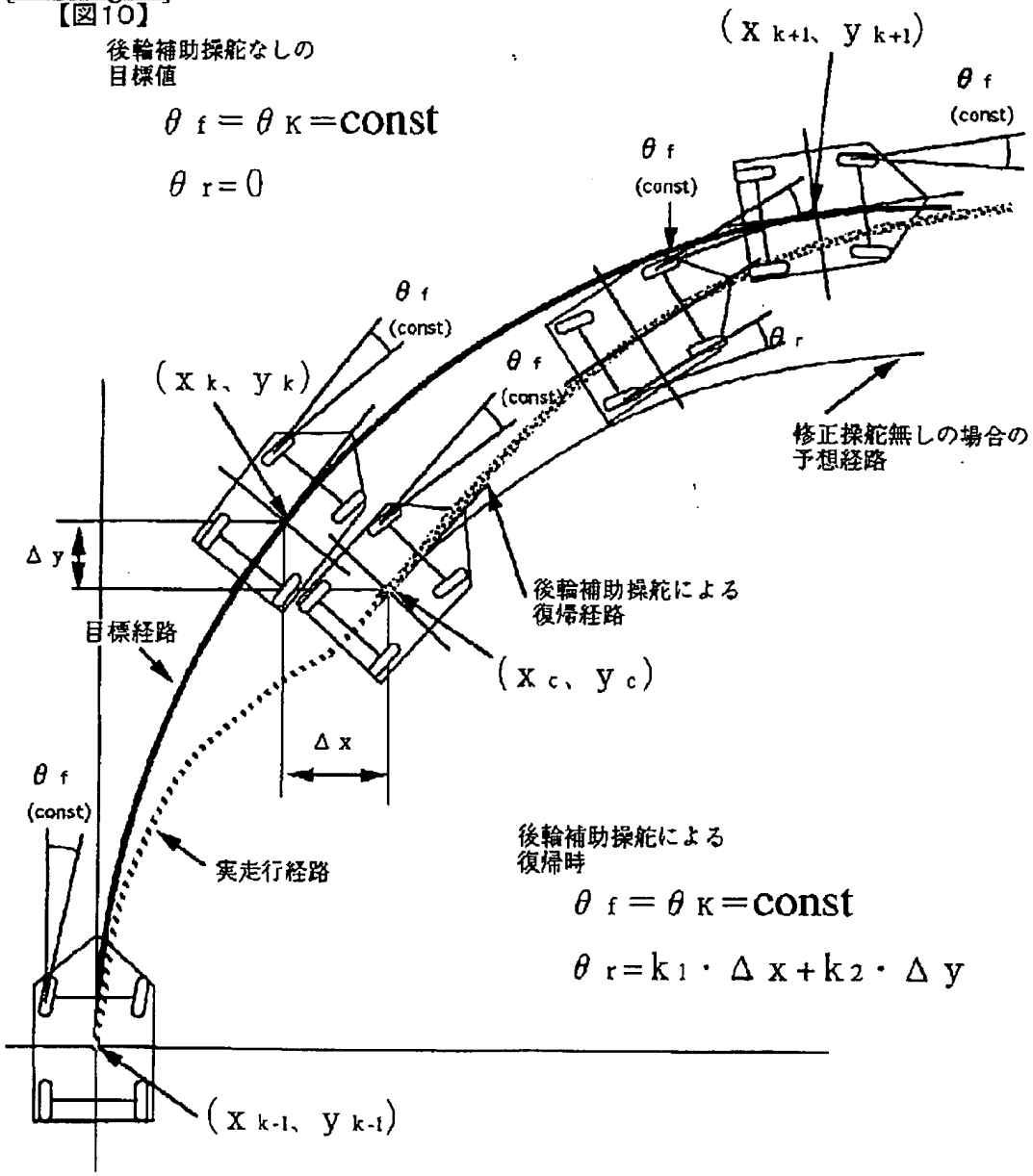
【図9】



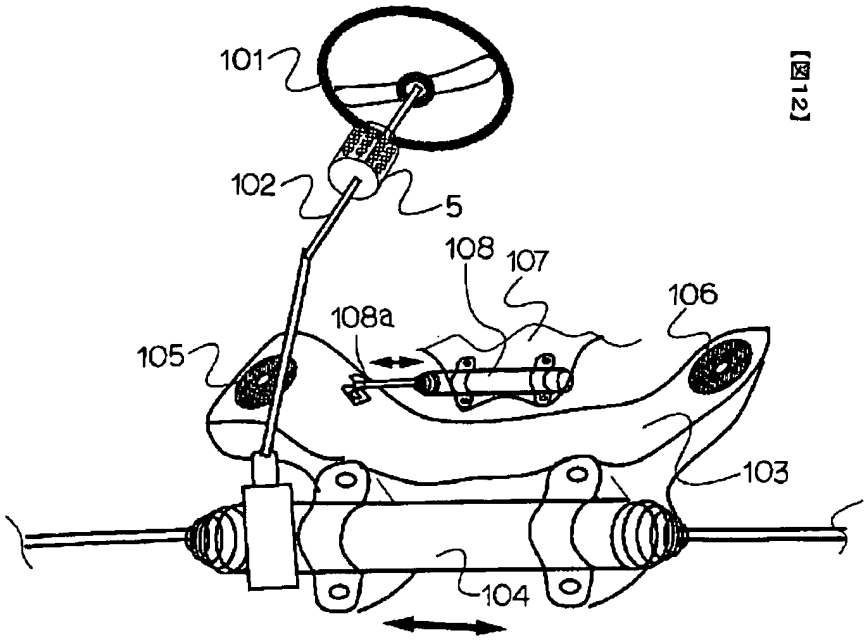
[Drawing 11]



[Drawing 10]

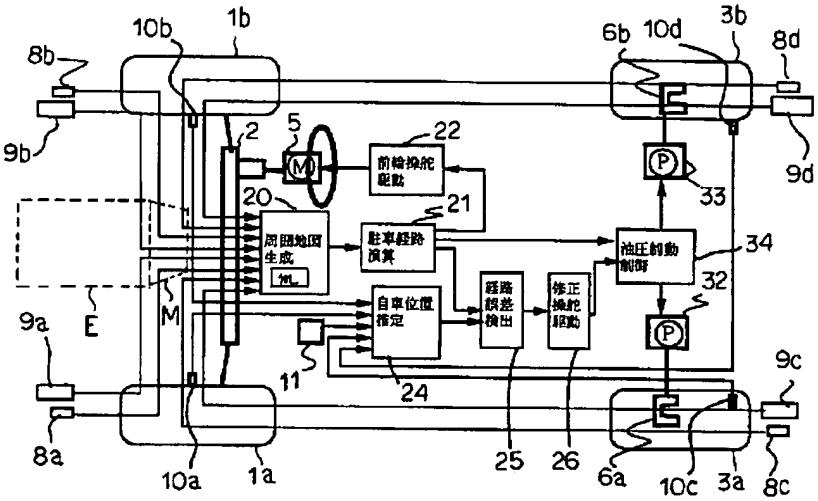


[Drawing 12]



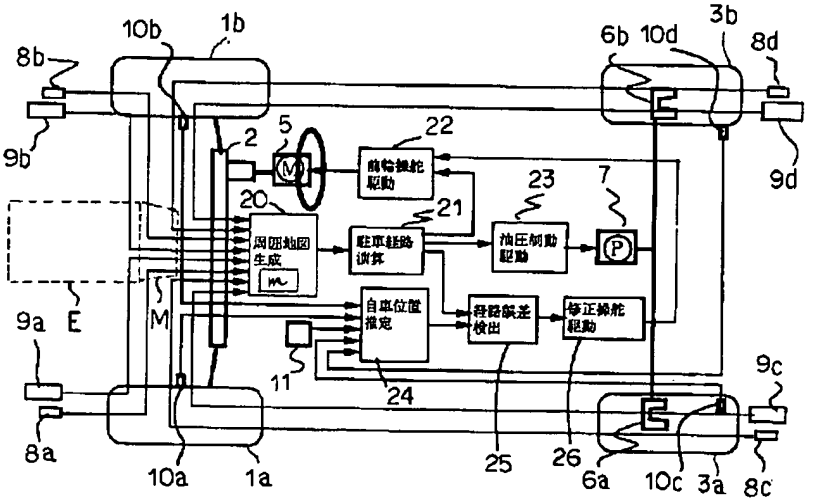
【図12】

[Drawing 13]



【図13】

[Drawing 14]



【図14】

[Translation done.]